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Husserlian and Fichtean Leanings: Weyl on Logicism, Intuitionism, and Formalism

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Résumé : Vers 1918 Hermann Weyl abandonnait le logicisme et donc la tentative de réduire les mathématiques à la logique et la théorie des ensembles. Au niveau philosophique, ses points de référence furent ensuite Husserl et Fichte. Dans les années 1920 il distingua leurs positions, entre une direction intuitionniste-phénoménologique d'un côté, et formaliste-constructiviste de l'autre. Peu après Weyl, Oskar Becker adopta une distinction similaire. Mais à la différence du phénoménologue Becker, Weyl considérait l'approche active du constructivisme de Fichte comme supérieure à la vision d'essences passive de Husserl. Dans cet essai, je montre ce développement dans la pensée de Weyl. Bien que certains points dans sa réception de Husserl et Fichte ne soient pas soutenables, je vais argumenter en faveur de la distinction fondamentale mentionnée ci-dessus.

Abstract: Around 1918 Hermann Weyl resisted the logicists' attempt to reduce mathematics to logic and set theory. His philosophical points of reference were Husserl and Fichte. In the 1920s, Weyl distinguished between the position of these two philosophers and separated the conceptual affinity between intuitionism and phenomenology from the affinity between formalism and constructivism. Not long after Weyl had done so, Oskar Becker adopted a similar distinction. In contrast to the phenomenologist Becker, however, Weyl assumed the superiority of active Fichtean constructivism over the passive Husserlian view of essences. The present paper discusses this development in Weyl's thought. Though not all of Weyl's claims about Husserl and Fichte can be maintained in detail, I will argue for the general plausibility of Weyl's distinction.

1 Introduction

Hermann Weyl was one of the greatest mathematicians of the last century. Within the last few years, his philosophical writings have also gained attention, in particular the way they were influenced by phenomenology as presented by its founder, Edmund Husserl. (See, for instance, [Ryckman 2005].) When

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he was a student of mathematics in Göttingen under David Hilbert, Weyl attended lectures by Husserl, who was then a professor of philosophy there.

However, after gaining his first chair in mathematics at the ETH in Zurich, Weyl, as he himself put it, got "deeply involved in Fichte" [Weyl 1946, 1]. (Translations throughout the paper are mine.) As further evidence of this involvement, Weyl attended a reading group on Fichte [Weyl 1948, 381] and also took extensive notes on Fichte's major works [Weyl (undated I)]. Weyl's strong involvement in the work of a German Idealist seems at first glance astonishing and, at least from the received view in contemporary philosophy, needs some explanation. Historically, Weyl's interest in Fichte was initiated by his Zurich colleague, the philosopher and Fichte expert Fritz Medicus. As Weyl acknowledges, it was also through Medicus that "the theory of relativity, the problem of the infinite in mathematics, and finally quantum mechanics became the motivations for my attempts to help clarifying the methods of scientific understanding and the theoretical picture of reality as a whole" [Weyl 1946, 1].

In this paper I will present Weyl's readings of phenomenology and Fichte's "constructivism" in relation to the philosophy of mathematics. In Section 2 Weyl's 1918 work on the continuum will be discussed against the background of the logicist programme, which attempted to reduce mathematics to logic and set theory, and how Weyl opposed it. Whereas in this work he refers to both, Husserl and Fichte, as his allies, Weyl made a clear separation between the two philosophers during the debate between intuitionism and formalism in the early 1920s. As discussed in Section 3, Weyl at that point linked intuitionism, which was favoured by him for only a very brief period, to Husserlian phenomenology and linked formalism to Fichtean constructivism. I will show that a similar distinction can also be found in the work of Husserl's model student in the philosophy of mathematics, Oskar Becker.

As the earlier quote from Weyl suggests, the debate about the problem of the infinite as it occurs in the analysis of the continuum, and in the intuitionism-formalism debate cannot be strictly separated from issues in physics. (See, for instance, [Sigurdsson 1991] and [Scholz 2001].) Indeed in the middle of the 1920s Weyl developed what he called an "agens theory" of matter, which attempted to accommodate recent results in relativity theory and atomic physics and which was also strongly influenced by Weyl's reading of Fichte. However, since this has been dealt with in detail elsewhere [Sieroka 2007], it will not be addressed in this paper.

The overall aim of this paper is to reconstruct how Weyl philosophically locates his own position during the debates between logicism, intuitionism and formalism. Although one obviously does not need to agree with the strong association of intuitionism and phenomenology, for instance, the following investigation shows that Weyl's claims and distinctions are understandable through considering the historical constellation in which his reading of Husserl and Brouwer arose.

This paper also contributes to two more detailed issues. Over the last few years, studies of Weyl have acknowledged his transcendental idealism but have mainly focused on its Husserlian leanings. The present study may help to get a more detailed picture of Weyl's idealism by locating his Fichtean leanings more properly (in particular since the few works that exist in this context are to some extent misleading, as will be considered below). The other issue concerns contemporary research that takes Fichte mainly to be a philosophical foundationalist who is disclosing some mystical self-relation of the ego. (See, for instance, [Henrich 1967].) In contrast to this well-known view, the present paper (following Weyl) indicates a constructivist reading of Fichte which seems not only possible but also very fruitful for philosophical debates about mathematics and physics.

2 Against logicism

In 1918 Weyl wrote a book entitled *Das Kontinuum* which attempted to give a foundation to analysis (to the calculus). At the very beginning of this book, Weyl engaged in a discussion of the pertinent antinomies, the most famous of which is the one by Russell about the set of all sets that does not contain itself as a member. The main point I want to make is that here Weyl refers to Fichte for the first time. He reveals one of those pertinent antinomies, namely the Grelling paradox (discussed below), as "scholasticism of the worst sort" and that asserts that, in this case, "one must seek advice from men, the names of whom cannot be mentioned among mathematicians without eliciting a sympathetic smile—Fichte, for instance" [Weyl 1918, 2]. The particular passage Weyl refers to in this quote is likely to be the lectures XXVIII–XXX of Fichte's *Transzendentale Logik* with their prominent distinction between finite and infinite judgements [Fichte 1834, 265–289].

Fichte was not a particularly gifted mathematician, as confirmed by the comments of several of his contemporaries. It was said, for instance, that "there was never a mathematical construction understood by him [Fichte]" and "when it comes to mathematics, I absolutely refuse to tolerate any instruction by Mr. Fichte" (quoted in [Radbruch 2003, 254]). Weyl, in his notes on Fichte, at one point writes: "Fichte is particularly funny, when he tries to express his philosophical constructs in mathematical form" [Weyl (undated I), 4]. So, rather than the pseudo-mathematical formalisations that one can find in Fichte at times, it is the overall philosophical project of constructivism that Weyl appreciates in Fichte. (Since the last quote refers to the section on the constitution of space in the *Grundriß des Eigentümlichen der Wissenschaftslehre* [Fichte 1795, 71–76], the interpretation in [Scholz 2004] might be confronted with a problem, for it draws heavily on exactly this passage to show parallels with Weyl's analysis of the problem of space.)

More broadly speaking, what Weyl is opposed to when writing about a "scholasticism of the worst sort" is logicism. For him, all attempts to reduce mathematics to logic and set theory are mainly a symptom of a typical "mathematician's disease" [Weyl 1919, 44]. To use Weyl's own example, it is mainly by an uncomprehending application of logic that the so-called antinomies, like Grelling's paradox about the word "heterological", appear. An adjective is said to be heterological if it is not the case that "the word itself possesses the property which it denotes" [Weyl 1918, 2]. Therefore, "long" is heterological since it is not a long word, whereas "short" is indeed short and hence not hetero- but autological. The alleged antinomy now appears if one asks whether the adjective "heterological" is itself heterological or not. Weyl claims that all alleged antinomies can be removed by using an intensional logic, which accepts that "the *meaning* of a concept is the logical prius as opposed to its *extension*" [Weyl 1919, 44]. As a philosophical point of reference for his own view, Weyl again mentions Fichte's *Transzendentale Logik*. Alongside this work, however, Weyl now also refers to Husserl's *Logische Untersuchungen* [Husserl 1900/01] as an important philosophical work opposed to an unlimited extensional view of logic.

In *Das Kontinuum* Weyl discusses the concept of the continuum both in relation to our experience of the continuous flow of time and in its mathematical use, wherein the set of real numbers is assumed to form a continuum. Weyl claims that his investigation contributes to "the epistemological question concerning the relation between the immediately (intuitively) given and the formal concepts (in the sphere of mathematics) by which, in geometry and physics, we seek to construct this given" [Weyl 1918, iv]. According to Weyl, it is of central importance for the philosophy of both mathematics and physics to distinguish between a sphere of construction and a sphere of something immediately given (a sphere of intuition). Together with distinguishing these two, according to Weyl it is also important to investigate their mutual relation.

In the case of mathematics, this distinction of spheres remains the main contrast in Weyl's writings about the debate between intuitionism and formalism, to which I will turn in the next section. (For a more detailed discussion of the issues in the philosophy of physics see [Sigurdsson 1991], [Ryckman 2005] and also compare Weyl's harsh critique of Rudolf Carnap's *Der Raum* [Weyl 1922].)

3 Passive intuitionism and active formalism

After about 1912, intuitionism was mainly developed by the Dutch mathematician L. E. J. Brouwer. (See, for instance, [Brouwer 1912].) In this approach, mathematics is understood in terms of the intuitive and exact thinking of an individual mathematician. So, instead of seeking out an inner-mathematical foundation via logic and set theory, as in logicism, intuitionism aims at a foundation "from outside," that is, via some non-mathematical given. In contrast, formalism as elaborated especially by David Hilbert is mainly concerned with the completeness and consistency of a formal system and not with its "truth" in any narrow sense. (See, for instance, [Hilbert 1928].)

For a brief period, Weyl strongly defended intuitionism. In his 1921 paper *Über die neue Grundlagenkrise der Mathematik*, he even talks about Brouwer as bringing "the revolution" that promises mathematicians' "salvation from an evil incubus" [Weyl 1921, 158, 179]. (The former quote afterwards developed a philosophical history of its own. Famously, a few years later Frank Ramsey wrote about the "Bolshevik menace of Brouwer and Weyl" [Ramsey 1925, 219], which in turn led Ludwig Wittgenstein to call Ramsey a "bourgeois thinker" [Wittgenstein 1977, 17].) However, Weyl's alliance with intuitionism quickly and considerably weakened, when it became apparent that intuitionism was a very ambitious project employing concepts which, at least from the point of view of a practising mathematician, were very restrictive.

Since the use of the law of the excluded middle is limited in intuitionism, proofs by contradiction, which are quite common in mathematics, often failed to be reproducible within this approach. Thus, as Weyl once put it, with intuitionism a huge part of mathematics "goes up in smoke" [Weyl 1925, 534]. This is not to say that Weyl in his later work did not adhere to some details of the intuitionist treatment of the infinite, but as a practising mathematician and theoretical physicist he retreated from the general foundational ambitions of intuitionism. In this respect, Weyl not only claimed a victory for formalism but also claimed a strong philosophical implication that along with intuitionism comes a "decisive defeat of pure phenomenology" [Weyl 1928, 149].

(Although, as a whole, this sentence from [Weyl 1928] is a conditional—saying that *if* intuitionism fails, then phenomenology would be defeated—it is evident from the context that Weyl holds the antecedent to be true; see also the quotation from Weyl in [Becker 1926–33, 249–250]. Moreover, even after Gödel had proven his incompleteness theorems in 1931, which gave a considerable blow to Hilbert's original programme, Weyl was not much concerned because of the wider notion of formalism and construction he had gained by then; see below, and for a more detailed discussion of Gödel's theorems [Weyl 1949a, Appendix A] and [Weyl 1951, 465, 494].)

In a letter to Husserl's pupil Oskar Becker written in 1926, Weyl maintained that with the victory of formalism "*theoretical construction* begins to look like the main epistemological problem that in the end is not bound to some intuitive foundation as an absolute and unexceedable frame" [Becker 1926–33, 249–250] (cf. also [Mancosu and Ryckman 2002]). Here Weyl connects intuitionism and phenomenology more closely via the concept of "intuition" (see below) and, speaking in modern terms, claims that both run afoul of the so called "myth of the given", the idea that there is something immediately given which at the same time is a piece of non-refutable and proper knowledge on which all other knowledge is firmly based [Sellars 1956]. Because many wrote about this during the second half of the twentieth century, it should be enough to note that already Fichte opposed this "myth". For instance, in his *Transzendentale Logik*, Fichte writes that "in knowledge there are no separated and single entities [...]. That someone might *know* about entities as being different from each other entails that he already *understands* this very difference, that he contrasts (*entgegensetzt*) and compares these entities; therefore, that he already has a general concept of these entities" [Fichte 1834, 12].

According to Weyl, intuitionism cannot adequately account for theoretical construction and also for the creativity (*das Schöpferische*) of science. For him, this goes along with a distinction between two approaches in philosophy, one that starts from an immediately given and from a passive viewing (*passive Schau*) and one that defends an active constructivism. As Weyl puts his own position in a pointed remark, "we do not have the truth; it does not suffice merely to open your eyes wide and then we shall see it; but we must *act* and parts of the truth will be revealed to us by our very action" [Weyl (undated II), 6–7]. (This quote is taken from an English manuscript, but nearly the same phrasing also occurs in one of Weyl's German papers [Weyl 1949b, 334].) It seems possible and perhaps even plausible to distinguish those two approaches, as Weyl does, along the lines of the philosophies of Husserl and Fichte. Indeed, one of the most important and even peculiar concepts of Husserlian phenomenology, which distinguishes it from nearly all other philosophies of the twentieth century, is the *Wesensschau*: the assumption that we can "intuit" or rather "view essences" if we reflect upon our mental acts [Tieszen 2005, 69].

In contrast, Fichte's philosophy, the "Doctrine of Knowledge" *Wissenschaftslehre*, famously starts from the ego as acting. At least in the early Fichte, this involves a constructivism with a strong kind of pragmatist dimension. Fichte maintains that "the Doctrine of Knowledge is to be a pragmatic history of the human mind" [Fichte 1794b, 141]:

> If our Doctrine of Knowledge gives an accurate account [...], then it is absolutely certain and infallible [...]; however, the question is exactly this, whether and to what extent our account might be appropriate; and thereupon we can never give a rigorous proof, but only one in terms of probabilities. [...] We are not the legislators of the human mind, but its historiographers; we are not, of course, journalists, but rather writers of pragmatic history. [Fichte 1794a, 69]

Thus, Fichte is certainly a constructivist, but need not necessarily be read as the stubborn aprioristic philosopher he is often taken to be. There is a possible and consistent pragmatist, anti-foundationalist reading of Fichte which can also be found in the recent literature [Rockmore 1995]. Weyl also was aware of this dimension and claimed that Fichte entered but did not fully develop a "third realm" over and above realism and idealism [Weyl 1925, 540]. To use Weyl's own phrase, there is a potential in Fichte which could be further developed into a modern "symbolic constructivism" [Weyl 1949b]. So, with respect to the distinction between the aforementioned philosophical approaches, it is clear that for Weyl, Fichte, rather than Husserl, was on the right track:

> [As compared to Husserl, Fichte] is anything but a phenomenologist, he is a constructivist of the purest sort, who—without looking

> left or right—goes his own headstrong way of construction. [...] As for the antagonism between constructivism and phenomenology, my sympathy is wholly on his side. However, the way a constructive procedure that leads towards symbolic representation, not a priori, but with continuous reference to experience, the way such a procedure can actually be carried out is shown by physics [...]. [Weyl 1954, 641, 643]

Again, the above quote shows Weyl's rather broad leanings to Fichtean constructivism, leanings that indeed allow him to even include Hilbert's axiomatic method in a wider family of constructivist approaches to the mathematical sciences. (That this quote also shows the blurry boundary between mathematics and theoretical physics is, again, not my topic here.) Given that this quote is from 1954, it also shows how Weyl continued to keep his earlier Fichtean motifs, for already in 1925 Weyl was writing about "theoretical construction" and "symbolic representation" in relation to Fichte [Weyl 1925, 540–542]. And so Weyl's "symbolic constructivism" can indeed be seen as an interpretation or elaboration of Fichtean philosophy, one that follows the frame of an anti-foundationalism rather than following the peculiar details of some a priori transcendental deductions that allegedly once and for all ground the exact sciences or their central concepts. Thus, according to Weyl, adopting a broad Fichtean framework is compatible with acknowledging the particular methods and empirical findings in the exact sciences. (Besides, this also explains Weyl's reference to Fichte rather than to one of the other most eminent German Idealists. Schelling and Hegel tend to be much more patronising and prescriptive when it comes to concrete practices and findings in the natural sciences, so that one would have many more problems reading them in this anti-foundationalist fashion.)

To avoid misunderstanding Weyl's distinction between an intuitionist-phenomenological and a formalist-constructivist approach, it should be added that there are, of course, differences between Brouwer and Husserl. In particular, given the importance of constructibility in intuitionism one might even argue that intuitionism would belong on the side of active construction rather than passive viewing. And so, as already mentioned, Weyl's distinction here must be viewed against his historical background. For it is rather the notion of "intuition" (*Anschauung*) that is important for him and from which the association of intuitionism and phenomenology appears plausible.

Indeed, Husserl himself never engaged in a detailed discussion of intuitionism, though it is documented that he met Brouwer in Amsterdam in 1928 and was very much impressed by him [van Atten 2004, 205]. Interestingly enough, with respect to his *Philosophie der Arithmetik* and his notion of "epitome" (*Inbegriff*) therein [Husserl 1891, 74–79], Husserl can be seen as being near to classical mathematics and to logicism [van Atten 2005, 113]. On the other hand, within recent philosophy of mathematics also a strong constructivist reading of Husserl has been proposed, particularly by Tieszen [Tieszen 2005, passim]. However, even here Weyl's distinction between different philosophical leanings remains significant. For Tieszen's phenomenological approach moves towards intuitionism at times, for instance, when he (like Brouwer) argues for a primacy of ordinal numbers over cardinal numbers [Tieszen 1989, 105]. This is opposed to what Husserl himself does in his *Philosophie der Arithmetik*, but seems in line with Husserl's later investigations on time-consciousness, where a sequential (ordered) structure lies at the foundation of all mental acts.

Thus, despite minor discrepancies, Weyl's distinction certainly still has a point to it. By hinting at the problem of passive viewing, Weyl very early on put a finger on a sore spot in Husserl's system. Weyl's critique, according to which it is not enough merely to "open our eyes wide" and to "see", dates from a time when none of Husserl's writings on passivity has yet been published. That later on Husserl deals with this topic so intensively in his *Analysen zur passiven Synthesis* [Husserl 1966], his *Formale und transzendentale Logik* [Husserl 1929] and also in *Erfahrung und Urteil* [Husserl 1939] shows how delicate it became for his phenomenology.

Oskar Becker also argued for a similar distinction of philosophical approaches in his 1927 work, *Mathematische Existenz.* Unlike his teacher Husserl, Becker was engaged in the mathematical details of intuitionism, such as choice sequences. He claimed that intuitionism and Husserlian phenomenology have common roots in the Kantian notion of intuition, whereas formalism is said to have Leibniz as its philosophical ancestor [Becker 1927, 714–747; Becker 1926–33, passim]. Not only does Becker explicitly mention Weyl as a defender of formalism, but also emphasises that Weyl's own interest in Leibniz originated from reading Fichte [Becker 1927, 726–727, 768]. Unfortunately, Becker does not develop this any further. But from the above statements, Weyl's reliance upon Fichte should now be obvious. Indeed, Weyl himself also explicitly states his high regard for Leibniz and, like Becker, closely relates him to Hilbertian formalism [Weyl 1925, 540]. For completeness it should be added that Fichte too thought highly of Leibniz, referred to Leibniz' concept of intuition [Fichte 1834, 10] and even called him "the only ever convinced person (*der einige Überzeugte*) in the history of philosophy" [Fichte 1797/98, 96].

Though Becker's distinction is similar to Weyl's (one might even speculate whether Becker might have taken it over from Weyl), their alliances are completely different. In opposition to Weyl, the phenomenologist Becker expected that formalism would be defeated soon. Becker's own critique on Hilbert, however, is not the issue here and has already been critically examined elsewhere [Peckhaus 2005].

4 Conclusion

Let me briefly summarise my sketch of Weyl's philosophy of mathematics from about 1918 to 1928. At the beginning of this period, by relying on both Fichte and Husserl, Weyl refrained from the logicist attempt to reduce mathematics to logic and set theory. Later on, after his brief alliance with Brouwer in 1921, Weyl distinguished between an intuitionistic-phenomenological and a formalistic-constructivist approach. At that time, Weyl came to believe in the superiority of Fichtean constructivism over the passive Husserlian viewing of essences, which seems not to do justice to the creativity of work done in mathematics and theoretical physics.

Thus, this paper has shown how Weyl's intellectual development and his claims about phenomenology, intuitionism, constructivism and formalism followed from certain historical constellations. Arguably, some of these claims are plausible more generally or at least are of particular interest insofar as they are not results of some detached "arm-chair philosophy" but rather originated from Weyl's actual scientific work in mathematics and physics. Having said that, whether Weyl's interpretation of Fichte and Husserl is tenable in detail from the perspective of contemporary philosophical scholarship has not been my main interest here (though I have mentioned some recent literature supporting this reading). To be sure, it never seemed to be *Weyl's* aim to become an expert Fichte or Husserl scholar. Yet, especially in the case of Fichte, Weyl's work may help to establish a possible and consistent reading which is of interest to the philosophy of science, an area in which so far Fichte has been neglected nearly completely (except perhaps for such works as [Heidelberger 1998]).

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